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On Budgetary Policies, Growth, and External Deficits in an Interdependent World*

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We investigate the effects of budgetary policies in a two-country model of overlapping generations and endogenous growth. In the presence of capital mobility, endogenous growth rates are equalized, but output levels do not converge. A worldwide rise in the public debt to GDP ratio or the share of government consumption reduces savings and growth. A relative rise in one country's debt to GDP ratio or its GDP share of government consumption results in a fall in external assets and its relative savings rate. In the short run, the fall in the savings rate is higher, and the country experiences higher current account deficits as a percentage of GDP. *J. Japan. Int. Econ.*, December 1991, 5(4), pp. 305-324. Department of Economics, Birkbeck College, University of London, London, United Kingdom; Athens School of Economics, Athens, Greece; and CEPR. CentER: Department of Economics, Tilburg University; and CEPR. © 1991 Academic Press, Inc.

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The 1980s have witnessed a slowdown in economic growth, a widening

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TABLE I
PUBLIC DEBT, GROWTH, AND CURRENT ACCOUNT DEFICITS IN EUROPE,
JAPAN, AND NORTH AMERICA

	1979			1989		
	Public debt (% GDP)	Growth rate (%)	Current account (% GDP)	Public debt (% GDP)	Growth rate (%)	Current account (% GDP)
North America	18.2	3.0	-0.2	30.5	2.7	-2.1
Europe	29.0	3.3	0.2	39.3	2.2	0.1
Japan	14.9	5.3	-0.9	14.1	4.2	2.0
Group of Seven	20.5	3.5	-0.2	30.0	2.8	-0.5

Note. The growth rate is the average over the previous decade, while the public debt and current account to GDP ratios refer to the respective years. North America consists of the United States and Canada and Europe of Germany, France, Italy, and the United Kingdom. The Group of Seven consists of the countries composing North America and Europe, plus Japan. The weights used to construct the averages are United States, 0.52; Japan, 0.17; Germany, 0.08; France, 0.07; Italy, 0.05; United Kingdom, 0.06; and Canada, 0.06. These are their shares in their combined 1987 GDP, at 1985 prices and exchange rates. The source for the original data was the database of the June 1990 OECD "Economic Outlook."

of current account imbalances, and significant rises in public debt to GDP ratios in the industrial economies. These latter rises were concentrated in North America and some European economies. The average net public debt to GDP ratio in the Group of Seven largest economies (G-7) rose by almost 10 percentage points, from about 20% in 1979 to 30% in 1989. The average growth rate fell from 3.5% per annum in the 1970s to 2.8% per annum in the 1980s. At the same time, the dispersion of fiscal and current account deficits increased. While the public debt to GDP ratio increased by about 10 percentage points in North America and Europe (see Table 1), in Japan it fell by about 1 percentage point between 1979 and 1989. Japan's current account deficit swung from a 1979 deficit of about 1% of its GDP to a surplus of 2% in 1989, while in North America the current account deficit rose from almost 0 to 2% of GDP.

This paper investigates the relation between budgetary policies, economic growth, and current account imbalances, in the context of a theoretical two-country model of endogenous growth with overlapping generations. The analysis assumes capital mobility and focuses on international spillovers from capital accumulation.

We demonstrate that, in the presence of perfect capital mobility, the endogenous growth rate will be the same in all countries and that relative output levels will not converge. Relative outputs and capital stocks are determined by exogenous differences in productive efficiency. The reason

for the equality of the endogenous growth rate is the real interest rate equalization implied by perfect capital mobility. As a result, the marginal product of capital must be the same in both countries. Capital will flow into the country with the more efficient productive technology until the marginal product of capital stock has been equalized in the two countries. After that, capital stocks need to grow by the same percentage to maintain this equality. Since the rate of growth of the capital stock determines the growth rate in this endogenous growth model, growth rates will then be equal.

With regard to the world economy we demonstrate that savings and growth rates are lower than those in a comparable representative-household economy. This is because in our overlapping-generations model households are not concerned about the welfare of yet unborn agents and therefore save less. Since the savings rate determines the rate of capital accumulation, and the latter determines the growth rate, growth will be slower in an overlapping-generations economy. We also demonstrate that the growth rate falls with increases in both the average public debt to GDP ratio and the average GDP share of public consumption. This is because both reduce global savings and, hence, capital accumulation. Such growth effects do not arise in representative-household economies (see Alogoskoufis and van der Ploeg, 1990a).

With regard to differences between countries, we demonstrate that relative increases in the public debt to GDP ratios and the GDP share of public consumption produce a relative fall in the share of external assets to GDP for the country that experiences them. This is because of the fall in its savings rate (private plus public). On impact, the fall in the national savings rate is higher than in steady state, and the economy enters an adjustment path along which it experiences higher current account deficits and a rising external debt to GDP ratio.

In conclusion, the results suggest that a two-country overlapping-generations model of endogenous growth can account for the events of the 1980s in terms of budgetary policies. The fall in the global growth rate could be a result of the average rise in public debt to GDP ratios, and the higher current account deficits of countries such as the United States could be the reflection of the relative rise in public deficits and public debt that they experienced. This latter result is also obtained in exogenous growth, overlapping-generations models, but such models cannot account for the growth effects of budgetary policies (see Frenkel and Razin, 1988; Obstfeld, 1988; van der Ploeg, 1990; Alogoskoufis, 1990; among others).

The rest of the paper is as follows: Section I presents an open economy model of overlapping generations and endogenous growth. The household sector consists of households with infinite horizons, but there is entry of

new households that are not intergenerationally linked, as in Weil (1989). This creates a consumption externality, as current households are not concerned with the welfare of future generations and save less than otherwise. Since savings determine investment in equilibrium, the investment rate is inefficiently low. The product market is competitive, but there are production externalities from the capital stock (or "knowledge") of other firms at home and abroad. Because of these production externalities, the marginal productivity of capital for individual firms is lower than the social marginal productivity of capital, and the equilibrium capital stock is inefficiently low. The government finances public consumption by either lump-sum taxes or public debt. It is assumed throughout that the government is solvent. Section II considers a two-country world in which both countries produce goods that are perfect substitutes in consumption. There are no barriers to international trade in goods or capital. We derive the equilibrium, discuss its properties, and consider the effects of alternative budgetary policies on the global growth rate and external debt. Section III contains conclusions.

I. AN OPEN ECONOMY MODEL OF OVERLAPPING GENERATIONS AND ENDOGENOUS GROWTH

Consider a world economy with no barriers to trade and in which each individual economy produces goods that are perfect substitutes in consumption. As a consequence, the law of one price holds.

Each economy consists of a large number of competitive firms, and a population of infinitely lived households which grows at the rate n . The government spends on public goods and can levy lump-sum taxes and issue debt.

I.1. *Households and Aggregate Consumption*

The basic model is a variant of the Weil (1989) model of overlapping infinitely lived households. New cohorts are not linked to preexisting cohorts through operative bequests.¹

¹ The infinite horizon assumption is not crucial. One could allow for finite horizons along the lines of the Blanchard (1985)–Yaari (1965) model, but the extra complexity buys little in terms of additional results. As Weil (1989) and Buiter (1988) have shown, the crucial difference between a representative-household and an overlapping-generations model is not finite versus infinite horizons, but rather the prospective arrival of new cohorts that are not linked to existing cohorts through operative bequests.

At time t , a household born at instant v solves the problem

$$\max_{c(v, s)} \int_t^{\infty} e^{-\rho(s-t)} \ln[c(v, s)] ds \quad (1)$$

subject to the instantaneous flow budget identity

$$\frac{da(v, t)}{dt} = r(t)a(v, t) + \omega(v, t) - \tau(v, t) - c(v, t), \quad (2)$$

where c is consumption, a is nonhuman wealth, ω is the gross instantaneous nonasset income of the household, and τ is the instantaneous tax she pays to the government. ρ is the pure rate of time preference and r is the instantaneous real interest rate.

Under the requirement that households are solvent (no Ponzi games) and that the real interest rate is time invariant, as is shown to be the case in equilibrium, one obtains the utility-maximizing consumption function for the individual household.²

$$c(v, t) = \rho[a(v, t) + h(v, t)], \quad (3)$$

where $h(v, t)$ denotes human wealth. This is defined as

$$h(v, t) = \int_t^{\infty} e^{-\lambda(s-t)} [\omega(v, s) - \tau(v, s)] ds. \quad (4)$$

In what follows we assume that newly born households do not inherit any nonhuman wealth, but that the other income ω and taxes τ are independent of the age of the household. Aggregate consumption is given by $C(t) = n \int_{-\infty}^t c(v, t) e^{nv} dv$. It is straightforward to show that aggregate consumption and nonhuman wealth evolve according to

$$\dot{C}(t) = [r - \rho + n]C(t) - n\rho A(t) \quad (5)$$

$$\dot{A}(t) = rA(t) + \Omega(t) - T(t) - C(t). \quad (6)$$

² The results that we derive in this paper are robust to more general specifications of the utility function. For the CES utility function, the household consumption function is modified to the form $c(v, t) = [\sigma\rho + (1 - \sigma)r][a(v, t) + h(v, t)]$, where σ is the elasticity of intertemporal substitution. If households faced a constant probability of death λ , as in Blanchard (1985), the consumption function would be $c(v, t) = [\sigma(\rho + \lambda) + (1 - \sigma)(r + \lambda)][a(v, t) + h(v, t)]$. Alogoskoufis and van der Ploeg (1990b) analyze such a model of endogenous growth and overlapping generations.

The menu of assets held by households consists of physical capital K , government debt D , and external assets F .

1.2. Technology and the Behavior of Firms

Each economy consists of a large number of identical competitive firms. The objective of these firms is to maximize their net worth.

Technology of firm j is given by

$$y(j, t) = \theta k(j, t)^{\eta_1} K(t)^{\eta_2} K^*(t)^{1-\eta_1-\eta_2}, \quad \theta > 0, 0 < \eta_1 + \eta_2 < 1. \quad (7)$$

where θ , η_1 , and η_2 are constant technological parameters, $k(j, t)$ denotes the capital stock of firm j at instant t , $K(t)$ denotes the average capital stock in the economy, and $K^*(t)$ denotes the average foreign capital stock. These two latter terms capture the external (or knowledge) effects of aggregate capital deepening in the economy and the rest of the world. Arrow (1962) and Romer (1986) have stressed such external effects in the context of a closed economy. Our model is the special case of the Romer model with constant returns to aggregate capital accumulation at the world level. Romer (1989) surveys the rapidly expanding literature on endogenous growth.

Firm j chooses a path for its capital stock that solves the problem

$$\max_{k(j, v)} \int_t^{\infty} [y(j, v) - \dot{k}(j, v) - \delta k(j, v)] e^{-\int_t^v r(u) du} dv. \quad (8)$$

The terms in brackets denote the instantaneous profits of firm j . δ is the rate of depreciation of the capital stock.

The first-order condition for a maximum entails

$$r(t) = \eta_1 \theta \left(\frac{k(j, t)}{K^*(t)} \right)^{\eta_1-1} \left(\frac{K(t)}{K^*(t)} \right)^{\eta_2} - \delta. \quad (9)$$

Equation (9) is the condition that the marginal product of capital is equal to the user cost of capital $r + \delta$. Since all domestic firms have the same technology and face the same market and nonmarket constraints (real interest rate and average domestic and foreign capital stocks), they will all choose the same capital stock. Thus, in domestic equilibrium, $k(j, t) = K(t)$ for all firms. The domestic asset market equilibrium condition then is

$$r(t) = \eta_1 \theta \left(\frac{K(t)}{K^*(t)} \right)^{\eta_1-1} - \delta, \quad (10)$$

where $\eta = \eta_1 + \eta_2$.

On the other hand, when (7) is aggregated across firms, the domestic aggregate production function is,

$$Y(t) = \theta K(t)^\eta K^*(t)^{1-\eta}. \quad (11)$$

I.3. *The Government*

The government finances public consumption G and interest payments on its debt rD by either lump-sum taxation T or borrowing D . This gives rise to the flow budget identity of the government,

$$\dot{D}(t) = rD(t) + G(t) - T(t). \quad (12)$$

Solvency of the government requires that the sum of the current public debt and the present value of future public consumption do not exceed the present value of future taxes:

$$\int_t^{\infty} e^{-\eta s - \eta} G(s) ds + D(t) \leq \int_t^{\infty} e^{-\eta s - \eta} T(s) ds. \quad (12')$$

II. ENDOGENOUS GROWTH, SAVINGS, AND EXTERNAL DEBT

Consider a two-country world. Preferences are the same in both countries, and there are no barriers to goods or capital flows across countries. Since the goods produced in any country are perfect substitutes in consumption, the law of one price will hold. Also, since assets are perfect substitutes internationally, both countries will face the same real interest rate.

We assume two differences across countries. The first is in the marginal productivity of capital, and is parametrized in terms of differences in θ 's. The second difference refers to fiscal policies. Countries are indexed by subscript i , where $i = 1, 2$.

II.1. *Asset Market Equilibrium*

The condition of perfect capital mobility implies that real interest rates will be equal across countries. From (10) and the assumption that the parameter θ differs across countries, we get that the world interest rate and relative capital intensities are determined by the condition that

$$r(t) = \eta_1 \theta_1 \left(\frac{K_1(t)}{K_2(t)} \right)^{\eta-1} - \delta = \eta_1 \theta_2 \left(\frac{K_1(t)}{K_2(t)} \right)^{1-\eta} - \delta. \quad (13)$$

Equation (13) can be solved for the equilibrium world real interest rate and the ratio of the equilibrium capital stocks:

$$r(t) = \eta_1(\theta_1\theta_2)^{1/2} - \delta \quad (14)$$

$$\frac{K_1}{K_2} = \left(\frac{\theta_1}{\theta_2} \right)^{1/2(1-\eta)} \quad (15)$$

From (14), the equilibrium world equilibrium real interest rate is time invariant as was assumed in Section I.1. It depends positively on the parameters determining the marginal productivity of capital stocks and negatively on the rate of depreciation of capital.

From (15), the country that, *ceteris paribus*, is more productive in its use of capital will end up with the higher capital stock. Substituting (15) in the aggregate production function (11), we get the equilibrium aggregate production functions

$$Y_1 = (\theta_1\theta_2)^{1/2}K_1 \quad (16a)$$

$$Y_2 = (\theta_1\theta_2)^{1/2}K_2. \quad (16b)$$

Equations (16a) and (16b) imply that, in equilibrium, the two economies will have the same capital-output ratio, which is constant and determined by the geometric average of θ_1 and θ_2 . In both countries, equilibrium output turns out to be proportional to the aggregate capital stock.

If growth in the level of domestic product is defined as $\gamma_i(t) \equiv \dot{Y}_i(t)/Y_i(t)$, then, from aggregate production functions (16a) and (16b), the growth rates of the capital stocks are also equal to $\gamma_i(t)$. Since from (15) the equilibrium ratio of capital stocks is constant, it follows that the equilibrium growth rates in the two economies must be equal. Thus, in this model there is no convergence of output levels. "Poor" (low- θ) countries have a lower output and capital stock than "rich" (high- θ) countries, but a common growth rate. Hence output levels do not converge. The rate of change of labor-augmenting technical progress, or the per capita growth rate, is defined as $\pi(t) \equiv \gamma(t) - n$. To the extent that both countries have the same rate of population growth, per capita output neither converges nor diverges. However, if the poor country had a higher rate of population growth, then per capita output would diverge between rich and poor.

Combine (16a), (16b), and (14) and note that $(r + \delta)K_i(t) = \eta_i(\theta_1\theta_2)^{1/2}K_i(t) \leq Y_i(t)$. Domestic output exceeds payments to owners of private capital. This is because domestic and international spillovers of knowledge induce additional income for which individual firms do not need to pay. We assume that these profits are handed over to the owners

of the firms (the household sectors) in a manner that does not depend on their age. This is consistent with our assumption in Section I.1 that $\omega(v, t) = \omega(t)$, i.e., independent of the age of the household. Therefore, $\Omega(t) = (1 - \eta_1)Y(t)$.

To summarize, this section has demonstrated that the equilibrium world real interest rate depends only on exogenous technological parameters. The relative capital stocks and output levels of the two economies depend only on differences in production efficiency and the capital-output ratio being the same in both countries. It has also demonstrated that the growth rate of GDP will be the same in both countries, and that there will be no tendency for economic convergence.³

II.2. *Goods and Labor Market Equilibrium*

Equilibrium in product markets requires that the sum of private consumption, public consumption, and investment equal national income. National income consists of domestic income Y , plus interest payments on external assets. Thus, in each economy, the product market equilibrium condition is

$$Y_i(t) + rF_i(t) = C_i(t) + \dot{K}_i(t) + \delta K_i(t) + G_i(t) + \dot{F}_i(t). \quad (17)$$

Equation (17) is based on the familiar accounting identity in an open economy, that national income is equal to absorption plus the trade balance. The trade balance is equal to the accumulation of external assets. Equation (17) can be rearranged to give the flow budget identity for the economy as a whole:

$$\dot{K}_i(t) + \dot{F}_i(t) = Y_i(t) + rF_i(t) - C_i(t) + \delta K_i(t) - G_i(t). \quad (17')$$

The accumulation of capital and foreign assets is equal to the excess of net national income over private and government consumption.

II.3. *Summary*

It is convenient to formulate the two-country model in terms of fractions of domestic product. These fractions are denoted by lowercase rather than capital letters, i.e., $c(t) = C(t)/Y(t)$. The model then is as follows:

³ The equality of growth rates follows from the assumption that the capital stock is internationally tradeable and freely adjustable. In Alogoskoufis and van der Ploeg (1991) we demonstrate that in the presence of adjustment costs for investment, the country facing the higher adjustment costs grows more slowly. Differences in growth rates are the main focus of the paper of Buiter and Kletzer (1991), where endogenous growth is due to the accumulation of nontradeable human capital.

$$\dot{c}_i(t) = [r - \rho + n - \gamma(t)]c_i(t) - n\rho[k + d_i(t) + f_i(t)], \quad (18)$$

$$\dot{d}_i(t) = [r - \gamma(t)]d_i(t) + g_i - \tau_i, \quad d_i(0) = d_{i0}, \quad (19)$$

$$\dot{f}_i(t) = 1 - [\gamma(t) + \delta]k - c_i(t) - g_i + [r - \gamma_i(t)]f_i, \quad (20)$$

$$k = \theta^{-1}, \quad \theta = (\theta_1\theta_2)^{1/2}, \quad (21)$$

$$\sum_{i=1}^2 \phi_i f_i(t) = 0. \quad (22)$$

Equations (18)–(20) are, respectively, the consumption function, the government flow budget identity, and the product market equilibrium condition for each economy. We have used the equilibrium condition that the rates of growth of capital stocks and, therefore, the growth rates are the same for both countries. Equation (21) is the equilibrium capital–output ratio, which is the same in both countries and equal to the geometric average of θ_1 and θ_2 . Finally, (22) is derived from the familiar budget identity that the foreign borrowing of country 1 equals the foreign lending of country 2. ϕ_i is the share of country i 's GDP in world GDP. The GDP shares are time independent in this model. It is straightforward to show that $\phi_1 = 1/[1 + (\theta_1/\theta_2)^{-1/(2(1-\eta))}]$. Obviously $\phi_2 = 1 - \phi_1$.

The simplest way to solve the model is to use the method of Aoki (1981) and consider the model of averages and the model of differences.

II.4 *Budgetary Policies, Savings, and Endogenous Growth in the World Economy*

We first consider the determination of worldwide averages. By taking the weighted average of the consumption functions (18), the government flow–budget identities (19), and the product market equilibrium conditions (20) for the two countries, using as weights their respective shares in world GDP, and after making use of (21) and (22), we end up with the following average model for the world economy:

$$\dot{c}_A(t) = [r - \rho + n - \gamma(t)]c_A(t) - n\rho[\theta^{-1} + d_A(t)], \quad (23)$$

$$\dot{d}_A(t) = [r - \gamma(t)]d_A(t) + g_A - \tau_A, \quad d_A(0) = d_{A0}, \quad (24)$$

$$\gamma(t) = -\delta + \theta[1 - c_A(t) - g_A]. \quad (25)$$

Subscript A denotes that the relevant variables refer to global weighted averages. Note that we have made use of (21) to substitute for the average capital–output ratio and (22), which suggests that average external assets are zero.

We first consider the determination of the GDP share of world private

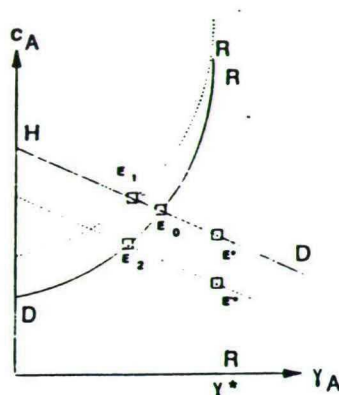


FIG. 1. The effects of budgetary policies on world consumption and growth rates.

consumption and the endogenous world growth rate, under the assumption of a constant world public debt to GDP ratio. This will be under the assumption that taxes adjust instantaneously to stabilize public debt. Thus, we concentrate on (23) and (25), assuming that the share of taxes is determined by

$$\tau_A(t) = [r - \gamma(t)]d_A(t) + g_A. \quad (24')$$

World equilibrium is depicted in Fig. 1. D-R depicts the steady-state consumption function in this Diamond (1965)–Romer (1986) overlapping-generations model. It is the locus of consumption–growth combinations that are consistent with the plans of private consumers and a constant GDP share of private consumption. Assuming a dynamically efficient world economy, in which the real interest rate exceeds the pure rate of time preference, i.e., that $\eta_1\theta - \delta > \rho$, the D-R locus is defined for per capita growth rates lower than $\eta_1\theta - \delta - \rho$. The steady-state consumption function asymptotically approaches the vertical R-R locus, which represents the Ramsey (1928)–Romer (1986) condition that the world per capita growth rate is equal to the difference between the real interest rate and the pure rate of preference. This condition, the modified golden rule, is satisfied at the point $\gamma^* = n + \eta_1\theta - \delta - \rho$.

The downward-sloping H-D line is the product market equilibrium condition (25). It is essentially a modified Harrod (1948)–Domar (1957) condition for the world economy. Ceteris paribus, a lower share of private consumption to world output leaves more room for investment, and the higher investment rate produces more growth. Unlike the model with decreasing returns to aggregate capital, growth never ceases in this model.

World equilibrium is at E_0 , the intersection of the D-R and H-D loci. Since both consumption and growth rate are nonpredetermined variables, there are no transient dynamics in the case of a fixed public debt to GDP ratio. Private consumption and the growth rate jump to ensure equilibrium in the global economy.

The equilibrium share of consumption is higher and the equilibrium growth rate lower than those in the case of an infinite horizon, representative-household global economy. This is because of the entry of new, nonintergenerationally linked households, which creates a consumption externality. Without this externality, the equilibrium is at E^* , the intersection of the H-D and R-R loci. In the representative household economy, the only growth rate which is compatible with a constant GDP share of private consumption is the Ramsey-Romer growth rate, $\gamma^* = n + \eta_1\theta - \delta - \rho$. In that case, only policies that operate through the marginal product of capital can affect growth rates.

We turn now to two fiscal policy experiments. The first is a tax-financed, steady-state rise in the world public debt to GDP ratio, and the second is a global balanced-budget increase in government consumption.

A global rise in the public debt-GDP ratio shifts the D-R locus to the left. Higher public debt increases consumption at a given growth rate, as part of the lump-sum taxes that will finance the interest payments on the higher public debt are paid by yet unborn generations, for which current generations are not concerned. In equilibrium, the rise in world consumption will reduce the growth rate, as it crowds out capital accumulation. Thus, the new equilibrium at E_1 is associated with higher private consumption and a lower growth rate. Such an effect does not arise in the case of a representative-household global economy, as in this case government bonds are not wealth (Barro, 1974), and the method of financing government expenditure does not affect private consumption.

A balanced budget global rise in the share of government consumption shifts the H-D locus. In the new equilibrium E_2 , both private consumption and the growth rate fall relative to the original equilibrium at E_0 . The higher taxes used to finance the rise in government consumption crowd out private consumption, but this crowding out is less than one for one, since part of the higher taxes are paid by new, nonintergenerationally linked households. As a result of this, the sum of global private and government consumption rises, total savings and investment get crowded out, and the growth rate falls. Such an effect does not arise in the representative-household economy, in which there is one-for-one crowding out of private consumption. In that case the economy moves from E^* to E'^* .

In Appendix I we consider the dynamics of consumption, public debt,

and economic growth, if taxes adjust only gradually, rather than immediately, to stabilize the global public debt to GDP ratio.

To summarize, this section has investigated the determination of global savings and endogenous growth. We demonstrated that the world savings and growth rates are lower than in a representative-household global economy, and that increases in both public debt and government consumption reduce the world GDP share of total savings and the global growth rate.

We now turn to the effects of differences in fiscal policies between countries.

II.5. *Relative Budgetary Policies and External Debt*

The model of differences between countries is used to examine the effects of relative budgetary policies in the two countries.

Subtracting the model (18)–(20) of country 2 from the model of country 1, we get the model of differences

$$\dot{c}_R(t) = [r - \rho + n - \gamma]c_R(t) - np[d_R(t) + f_R(t)], \quad (26)$$

$$\dot{d}_R(t) = [r - \gamma]d_R(t) + g_R - \tau_R, \quad d_R(0) = d_{R0}, \quad (27)$$

$$\dot{f}_R(t) = [r - \gamma]f_R - [c_R(t) + g_R], \quad (28)$$

where subscript R denotes the difference of the relevant ratio between country 1 and country 2.

We again concentrate on experiments with constant relative public debt to output ratios. Thus, relative tax rates are assumed to adjust instantaneously to stabilize the relative public debt to GDP ratios. Appendix 2 examines the stability of the relative model when the relative tax rates adjust sluggishly.

With a constant relative public debt to GDP ratio, the model consists of (26) and (28). It determines the differences in GDP shares of private consumption and the differences in net external asset to GDP ratios.

The equilibrium is depicted in Fig. 2. The constant relative consumption locus has a positive slope, as in world equilibrium $\gamma < r - \rho + n$. If the relative public debt to GDP ratio of country 1 is positive, it will also have a positive intercept. The slope of the locus of constant relative foreign assets could be either positive or negative, depending on whether the real interest rate exceeds or falls short of the growth rate. The case depicted in Fig. 2 is based on the assumption that $r > \gamma$. It is also assumed that the GDP share of public consumption in country 1 is higher than that in country 2.

The necessary and sufficient condition for the equilibrium to be saddlepoint stable is that

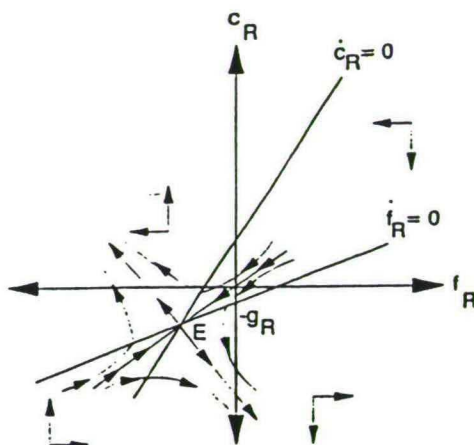


FIG. 2. Equilibrium of relative consumption and foreign assets.

$$np > [r - \rho + n - \gamma][r - \gamma]. \quad (29)$$

This condition will be satisfied if individual households are solvent and is assumed in Fig. 2.

We next consider the implications of a tax-financed rise in the relative debt to GDP ratio of country 1 and a tax-financed increase in its relative share of government consumption. These two experiments are depicted in Fig. 3.

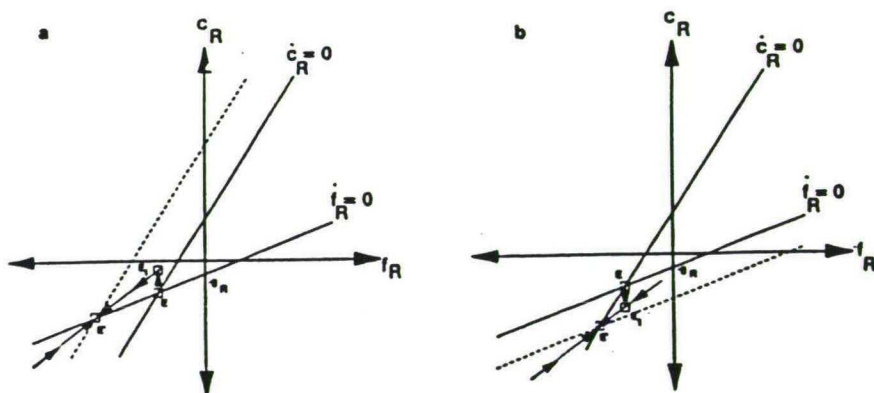


FIG. 3. (a) A tax-financed steady-state increase in relative public debt. (b) A tax-financed steady-state increase in relative public consumption.

Figure 3a depicts the case of a steady-state increase in the public debt to GDP ratio of country 1, relative to country 2. This shifts the constant relative consumption locus to the left, and the new equilibrium E' is associated with lower relative consumption and a higher external debt for country 1. Initially relative consumption rises as it jumps to put the economies at E_1 on the negatively sloping saddlepath. Subsequently, the relative share of private consumption is falling as country 1 decumulates foreign assets (accumulates foreign debt). Thus the adjustment path is characterized by higher than steady state relative consumption for country 1 and a current account deficit.

Figure 3b depicts the case of a relative increase in the share of government consumption in country 1. This shifts the constant foreign assets locus to the right, and in the new steady-state equilibrium, country 1 has a lower relative ratio of private consumption to GDP and a higher external debt. The initial fall in relative consumption undershoots the steady-state fall. However, as there is decumulation of foreign assets (accumulation of foreign debt) along the new saddlepath, the relative consumption share gradually approaches its lower equilibrium value at E' .

To recapitulate, we have shown that in a world of full capital mobility, an increase in the public debt to GDP ratio in one country will cause a reduction in that country's relative GDP share of private (and national) savings to GDP and a rise in its external debt to GDP ratio. On impact, the reduction in private savings is higher than in steady state, and the economy enters an adjustment path along which it experiences higher current account deficits and a rising external debt to GDP ratio. On the other hand, a (relative) rise in the output share of public consumption also reduces national savings, as the reduction in the (relative) GDP share of private consumption is lower than the increase in share of public consumption. As on impact the fall in the relative GDP share of private consumption undershoots the steady-state fall, the economy experiences an adjustment path characterized by higher current account deficits, a rising external debt to GDP ratio, and a falling GDP share of private consumption.

III. CONCLUSIONS

This paper has examined the implications of budgetary policies for growth and international borrowing and lending, in a two-country model of overlapping generations and endogenous growth. It has demonstrated that in the presence of perfect capital mobility, endogenous growth rates are equalized across countries, and that per capita output levels do not converge.

A rise in average public debt to GDP ratios or the average GDP share of public consumption reduces the global growth rate. The average GDP share of private consumption rises following a rise in the average public debt-GDP ratio, while it falls following a rise in the GDP share of public consumption. However, in the latter case, there is less than full crowding out, and this is the reason that the global savings rate falls and growth slows down.

A relative rise in the public debt to GDP ratio in one country causes a reduction in its external assets to GDP ratio. Its relative GDP share of private consumption rises, but then gradually falls as the country experiences higher current account deficits and decumulates foreign assets. In the new steady state, its relative savings rate will be either higher or lower than before the change, depending on whether the real interest rate exceeds the growth rate or vice versa. A relative rise in the GDP share of public consumption in one country will cause a relative reduction in the GDP share of private consumption. However, as there is less than full crowding out, because of overlapping generations, the country's relative national savings rate will fall. This will bring about higher current account deficits and a gradual reduction in its external assets to GDP ratio. This reduction will cause a gradual rise in its relative GDP share of private savings, which will eventually stop the external asset decumulation.

This model goes a long way toward accounting for the events of the 1980s. It not only explains the decumulation of external assets in the United States, relative to those in Western Europe and Japan, but it also explains the global slowdown in growth.

APPENDIX I

The Dynamic Adjustment of World Savings, Public Debt, and Endogenous Growth

In this appendix we consider the effects of a transitory tax cut on the dynamic adjustment of the average GDP share of private consumption, public debt, and endogenous growth in the world economy. For this purpose we use the average model consisting of Eqs. (23) to (25). We supplement the model by a tax rule that is assumed to ensure solvency of the public sector. This tax rule takes the form

$$\tau_A(t) = \tau_0 + \tau_1 d_A(t). \quad (A1)$$

Equations (A1) substitutes the tax rule (24') in the text. Unlike (24'), which

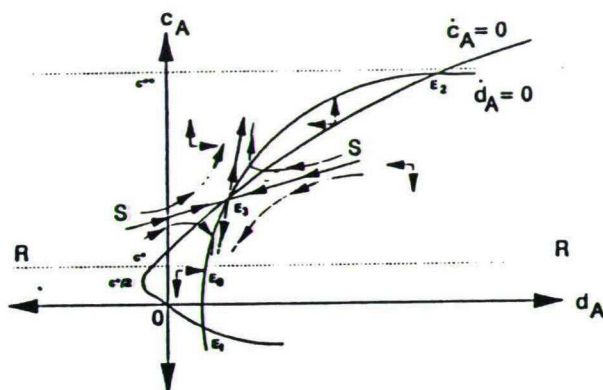


FIG. 4. Dynamics of average public debt and private consumption.

assumes immediate adjustment to ensure a stable public debt to GDP ratio, (A1) implies gradual adjustment.

Substituting (A1) in (24) and growth rate eq. (25) in (23) and (24), we obtain the following model for the average GDP share of private consumption and the average public debt to GDP ratio:

$$\dot{c}_A(t) = [r - \rho + n + \delta - \theta(1 - g_A)]c_A(t) + \theta c_A^2(t) - n\rho[\theta^{-1} + d_A(t)] \quad (A2)$$

$$\dot{d}_A(t) = [r + \delta - \theta(1 - g_A) - \tau_1]d_A(t) + \theta c_A(t)d_A(t) + g_A - \tau_0. \quad (A3)$$

The condition for government solvency is that $\tau_1 > r - \gamma_A = r + \delta - \theta(1 - c_A - g_A)$.

The equilibrium and the associated dynamics are depicted in Fig. 4. The locus associated with a constant share of consumption is negatively sloped for low shares of private consumption, since a low share of private consumption leaves more room for investment. This results in a per capita growth rate that is higher than the difference of the real interest rate and the pure rate of time preference weighted by the elasticity of intertemporal substitution. The slope of the locus turns positive at the point where the share of consumption is high enough to ensure a per capita growth rate lower than this latter difference. This is at the point $c_A^* = \frac{1}{2}c^*$. $c^* = 1 - g_A - \theta^{-1}[r - \rho + n + \delta]$ denotes the equilibrium GDP share of consumption associated with the Ramsey-Romer rule, i.e., a representative household economy. $\frac{1}{2}c^*$ also denotes the minimum average public debt to GDP ratio, or the highest percentage of GDP that the private sector is prepared to borrow from governments. Note that the Ramsey-Romer share of

steady-state E' , with a higher share of consumption and a lower growth rate.

APPENDIX 2

The Dynamic Adjustment of Relative Savings, External Debt, and Relative Public Debt

In this appendix we consider the stability of the relative model in (26)–(28), under gradual adjustment of relative tax rates to stabilize differences in the public debt to GDP ratio. Thus, the tax rule takes the form

$$\tau_R = \tau_0 + \tau_1 d_R. \quad (A4)$$

When (A4) is substituted in (27), the characteristic polynomial of the amended dynamic system (26)–(28) is given by

$$\phi(\mu) = (r - \gamma - \tau_1 - \mu)\{\mu^2 - [2(r - \gamma) - \rho + n]\mu - n\rho + (r - \gamma)(r - \rho + n - \gamma)\}. \quad (A5)$$

Since the system consists of one nonpredetermined and two predetermined variables, saddlepath stability requires two stable (negative) roots and one unstable (positive) root. It is straightforward to see that in the case where the public sectors are solvent, i.e., $\tau_1 > r - \gamma$, saddlepath stability is satisfied if (29) is also satisfied, i.e., if the private sectors are also solvent. If the public sector is solvent, the root associated with public debt is given by $\mu_1 = r - \gamma - \tau_1 < 0$, while if the private sector is solvent, ((29) is satisfied), the product of the other two roots will be negative, suggesting that one is negative and the other positive. Hence, the saddlepath condition will be satisfied.

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